Docket File

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ENVIRON, FILE (NEPA)

Daniel R. Muller, Assistant Director for Environmental Projects, L

REVISED RADIOLOGICAL IMPACT SECTION OF THREE MILE ISLAND DES

Plant name: Three Mile Island
Licensing stage: OL
Docket number: 50-289, 320
Responsible branch: Environmental Projects Branch-4
Project manager: J. D. Jenkins
Date request received by RA-L: November 9, 1972
Requested completion date: November 15, 1972
Description of response: Recalculation of doses based on revised source term.
Radiological Assessment Branch review status: Complete

F. Congel, RA-L, has recalculated the doses which appear in the Radiological Impact section of the Three Mile Island DES using the revised source term submitted by the Effluent Treatment Systems Branch. Attached are the text and tables with the corrected values.

/s/ B Grimes
for
Harold R. Denton, Assistant Director
for Site Safety
Directorate of Licensing

Enclosure:
As stated

cc w/o encl:
A. Giambusso
W. McDonald

cc w/encl:
S. Hanauer,
J. Hendrie
W. R. Regan
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J. Kastner
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DATE ▶	11/15/72	11/15/72	11/15/72			

Form AEC-318 (Rev. 9-53) AECM 0240 ☆ U.S. GOVERNMENT PRINTING OFFICE: 1972-466-984

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conditions. The quantity of radioactivity that is released to the environment will be a small fraction of the limits set forth in 10 CFR Part 20 of the Commission's Regulations, and the amounts will be kept as low as practicable in accordance with 10 CFR Part 50.36a. These regulations apply to the combined releases from all systems connected with both Units 1 and 2. The Staff has made calculations of the radiation dose using the estimated release rates of radionuclides listed in Tables 4, 5 and 6 using stated assumptions relative to dilution, biological reconcentration in food chains, and use factors by people.

2. Radioactive Materials Released to the Atmosphere

The most significant radiation dose to the public will result from the radionuclides in the gaseous effluents from the plant. The radioactive materials released to the atmosphere are principally the fission-product noble gases, krypton and xenon. Nearly all of the dose received by persons living, working or using recreational facilities in the vicinity of the plant will result from radioactive krypton and xenon in the air surrounding the individual. The postulated gaseous effluents from the plant are listed in Tables 4 and 5. We have calculated the potential annual doses using averages for meteorological conditions and assuming releases of the listed isotopes at a constant rate.

During normal operation of the plant at full power, the maximum dose rate due to cloud immersion at the plant's exclusion boundary on the river bank (2170 ft. ESE) where the X/Q = 9.1 x 10^{-6} sec/m^3, is calculated to be about 0.72 mrem/yr while the dose at the nearest community (Goldsboro, 1-1/2 miles W) is less than 0.10 mrem/yr. The annual dose (outside) at the nearest home (2340 ft. E, X/Q = 4.8 x 10^{-6} sec/m^3) is estimated to be 0.38 mrem/yr. However, a higher dose of 0.57 mrem/yr will be received at another home located 2460 ft. ESE, where a higher X/Q of 7.4 x 10^{-6} sec/m^3 is calculated. Assuming an occupancy of 3 months annually, the total body dose to campers at Beach Island (2080 ft. SW) and Shelly's Island (2000 ft. W), both normally uninhabited, would be about 0.52 mrem/yr and 0.14 mrem/yr, respectively. The dose also based upon three months per year occupancy, at the proposed recreational area at the southern end of Three Mile Island will range from about 0.10 mrem/yr at a point near York Haven Dam (3500 ft. S) to about 0.05 mrem/yr at the southern tip of the Island (8500 ft. S). A fisherman, pleasure boater or sunbather who spends 500 hours per year just outside the exclusion line at the nearest point on Shelly's Island would receive less than 0.01 mrem/yr due to gaseous effluents. Higher doses, of course, would be received by a fisherman, swimmer, or boater who inadvertently violated the plant exclusion circle. For example, at a shore on Three Mile Island nearest the plant (inside the exclusion circle 830 ft. SW, where the X/Q is as high as 1.4 x 10^{-4} sec/m^3), a fisherman or boater spending 500 hours per year would receive about 0.63 mrem/yr from gaseous effluents.

Based on an annual release rate of 0.25 Ci/yr of iodine-131, the thyroid dose due to inhalation would be less than 1.1 mrem/yr at the exclusion line (2170 ft. ESE), less than 0.9 mrem/yr at the nearest home, 0.2 mrem/yr at the nearest town (Goldsboro) and 0.7 mrem/yr at the proposed recreation area (3500 ft. S).

Radioactive iodine may be ingested by milk cows after deposition in grazing areas. Radiation exposure to the thyroid gland can result from drinking milk from these cows. A liter of milk consumed daily from a cow grazing five months per year at the nearest dairy farm (1-1/2 miles ESE , $X/Q = 1.6 \times 10^{-6}$ sec/m^3) would result in a dose to an infant's thyroid of about 19 mrem/yr.

3. Radioactive Materials Released to Receiving Water

During normal operation of the plant, the liquid radwaste effluent will be combined with the forced draft cooling tower blowdown before release into the Susquehanna River. Calculation of radiation doses from radionuclides released into the liquid effluent requires estimating the concentrations of these radionuclides at the point of discharge. A nominal flow rate of 36,000 gallons per minute (80 cfs) for the cooling tower blowdown was used to calculate the liquid radwaste dilution in the discharge canal. The river flow ranges from a low of 1,600 cfs to a maximum flood level of 740,000 cfs with an average annual flow of 34,000 cfs. Thus, an additional factor of 100 was conservatively assumed in order to estimate the effluent dilution after mixing with the river water.

The principal pathways leading to exposure doses to man are drinking water from the river, consuming fish and invertebrates caught in the river, and swimming, boating, and picnicking in or on the shore of the river. Bioaccumulation factors used to calculate doses from fish and invertebrate consumption are listed in Table 11. The doses to individuals resulting from the previously mentioned pathways are calculated using the estimated annual nuclide liquid releases given in Table 6 and dilution factors described above. In addition, it was assumed that each person drinks 1,200 cc of water per day, consumes 20 grams of invertebrates per day, swims 100 hours per year, and goes boating and picnicking on the shoreline for 500 hours per year. A delay of twenty-four hours is assumed between release and consumption. No delay factor is considered for recreational use. The results of the individual dose calculations are summarized in Table 12.

4. Radioactive Materials Stored on Site

The dose contribution at and beyond the site boundary due to radioactive storage areas on site is expected to be negligible.

5. Population Doses From All Sources

Values of the cumulative dose to the population from gaseous effluents based on 1970 census figures are listed in Table 13 for various distances from the station. The combined dose to all individuals living within fifty miles of the station (1,868,000) from exposure to radioactive gaseous effluents is estimated to be 2.1 man-rem per year. It was assumed that 5 percent of this total population would be exposed while fishing, ~~boating~~ or picnicking in the immediate vicinity of the plant.

The dose from ingesting fish and invertebrates was estimated by assuming that 10 percent of the total population within a fifty mile radius of the station obtained 25 percent of this intake from the Susquehanna River. Thus, the effective exposed population via this pathway is 47,000. The combined annual population dose via the drinking water, fish, invertebrate, recreation and transportation (of nuclear fuel and solid radioactive waste) pathways is calculated to be 31 man-rem.

The population dose from all of the above pathways is summarized in Table 14.

TABLE 12

ANNUAL DOSES AT EQUILIBRIUM CONDITIONS
TO INDIVIDUALS AT VARIOUS LOCATIONS

LOCATION	PATHWAY	GI TRACT (DOSE (MREM/YR))	THYROID (DOSE (MREM/YR))	TOTAL BODY (DOSE (MREM/YR))
Exclusion Boundary (2170' ESE)	Cloud	--	1.1	0.72
Residence[1] (2340' E)	Cloud	--	0.62	0.38
Residence[1] (2460' ESE)	Cloud	--	0.83	0.58
Goldsboro (nearest town 1.5 miles W)	Cloud	--	0.15	0.10
Three Mile Island Recreation Area[2] (3500' S)	Cloud	--	0.15	0.10
Shelly's Island (2000' W)	Cloud	--	0.21	0.14
Dairy Farm[3] (1.5 miles E)	Cloud, Ingestion of milk	--	18.5	0.13
Susquehanna River	Drinking water	0.009	0.50	0.025
	Fish Consumption	0.010	0.010	0.14
	Invertebrate Consumption	0.003	0.050	0.034
	Swimming	--	--	0.0001
	Picnicking and fishing on shoreline	--	--	0.041

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[1]No shielding was assumed.

[2]Dose calculation assumes an occupancy of 3 months per year.

[3]Dose to a child's thyroid based on consuming one liter of milk daily from a cow grazing five months per year at that particular farm.

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Table 13

Radius (miles)	Cumulative Population *	~~Annual~~ Cumulative Dose (man-rem/yr)	Average Individual Dose (mrem/yr)
1	580	0.050	0.086
2	2,350	0.12	0.049
3	9,000	0.23	0.025
4	17,300	0.29	0.017
5	24,500	0.34	0.014
10	136,400	0.76	0.0056
20	621,300	1.43	0.0023
30	995,200	1.79	0.0018
40	1,235,000	1.85	0.0015
50	1,868,000	2.05	0.0011

* Based on 1970 Census Data given in Three Mile Island Environmental Report, Operating License Stage

Table 14

Annual Dose to the General Population from the Operation of the Three Mile Island Plant

Pathway	Exposed Population	Cumulative Dose (man-rem/yr)
Cloud Immersion	1,868,000	2.1
Drinking Water	200,000	5.0
Ingestion of Fish	47,000	6.6
Ingestion of Invertebrates	47,000	1.6
Recreation:		
Swimming	93,000 ~~187,000~~	>0.1
Fishing and ~~Boating~~ Picnicking	93,000 ~~187,000~~	3.8
~~Pic Picnicking~~	~~93,000~~	
Transportation of Nuclear Fuel and Solid Radioactive Waste	400,000	12.0
	Total	~ 31

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